COMMANDERS DIGEST
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To view Research, Development, Test & Evaluation (RDT&E) expenditures for Command and Control and Communications (C^3) in proper perspective requires an understanding of the changing mission of this far-flung network and the urgent needs which currently beset it.

Flexibility in employment of our diverse military forces is enhanced by reliable, survivable and secure command and control and communications systems. The C^3 systems are interlaced throughout the total DoD structure; the land, sea and aerospace forces, and their supporting elements. Effective C^3 requires that all of the individual parts be coordinated so that the appropriate mix of military power can be brought to bear on a crisis or war situation in precise response to and under the positive control of the proper national authorities. These C^3 systems should be interoperable and capable of providing rapid and secure communications between a variety of levels of command, between forces of the various Services and between the United States and its allies.

The ability to exercise command control of our forces has become increasingly significant during recent years due to the increasing complexity of the tasks facing us coupled with decreasing force levels. As the Soviets approached nuclear weapon parity, our ability to reliably and selectively command and control our nuclear forces grew in importance, and became more difficult. Today's nuclear strategy includes the added dimension of carefully controlled limited nuclear options, which places new additional demands on the C^3 systems. We must always be able to respond to many types of crisis situations, and be able to choose a response to any type of threat. These range from various applications of conventional forces, through the entire spectrum of nuclear options, to strategic nuclear exchange. Any weakness in this ability would degrade our confidence in controlling potentially escalating situations. The challenge for our C^3 is to permit this full range of force application options, recognizing both the vastness of geography and the limitations of the forces we have available.

Our present C^3 resources were not systematically designed to accommodate today's requirements. In general, they were introduced gradually, in response to an increased threat or to take advantage of advancing technology. They range from those resources meeting unique requirements such as the execution of our strategic nuclear forces, to others that meet the day-to-day operating requirements of our forces. No encompassing systematic plan has been available. The result has been the acquisition of several individual subsystems that can be broadly categorized into special and general purpose C^3 resources. Although requirements for some special purpose systems will remain, we must plan our basic C^3 system to be able to operate in response to force command and control requirements across the broad spectrum of operations described.

This is not to say, however, that our present resources are not applicable to today's situation. Although they have the flexibility to be used effectively in response to the present C^3 environment, they must be integrated into an overall plan to insure efficient employment and to avoid duplication of capabilities in future procurement.

In recognition of the past lack of a system approach, several highly significant actions have been taken. Most important have been the establishment of the World Wide Military Command and Control System (WWMCCS) Council and the creation within the Office of the Secretary of Defense (OSD) of the Director, Telecommunications and Command and Control Systems (DTACCS). Closely following upon the creation of the DTACCS was the WWMCCS Council decision in February 1974 to seek a master plan, an "architecture," for a system which will be based on the identification and satisfaction of our C^3 needs, to the extent technology and the reasonable application of defense dollars will permit. The effort to develop C^3 requirements and architecture to satisfy those requirements is now underway. To implement the appropriate architectural option selected by the WWMCCS Council, we will identify an organization within DoD to follow on the architectural role and to engineer, implement and manage the C^3 systems capabilities.

The requirements for C^3 should receive the highest priority within the systematic approach described above, and they should evolve in response to national policy objectives, the threat, and our force structure. However, already recognized urgent requirements cannot be delayed while awaiting the final architectural design.

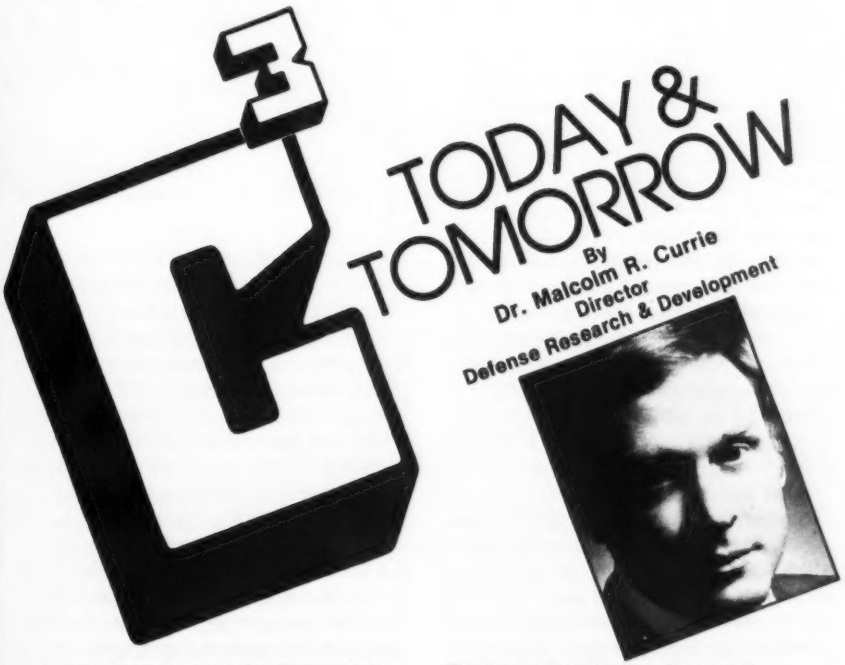
WWMCCS

The operational direction and administrative support of U.S. military forces worldwide is conducted through the World Wide Military Command and Control System (WWMCCS). The national level elements of this system, the National Military Command System (NMCS), include the National Military Command Center (NMCC) in the Pentagon and two alternate command facilities designed to enhance survivability. The President, no matter where he may be, at the White House, Camp David, or airborne in the Presidential aircraft, is always kept in continuous communications with the NMCS and, through it, with the Alternate National Military Command Centers, subordinate commands and the military forces. The National Military Command System is linked to the commands and the military forces

worldwide by a variety of general and special purpose communications modes.

During the next few years, we propose to significantly improve the security and survivability of the WWMCCS communications, particularly that portion designated as the Minimum Essential Emergency Communications Network (MEECN). The MEECN is the survivable system for communicating executive orders to our forces in wartime.

Connections between the national level command centers and the Strategic Air Command (SAC) forces



are provided through a deliberately redundant system of communications and command posts. SAC, in addition to its principal command post at Omaha, Nebraska, also maintains an airborne command post. The SAC airborne command post is in continuous communication with the SAC command post at Omaha. On receipt of warning of a nuclear attack on the United States, the SAC airborne command post would be linked to the SAC forces and the National Military Command System by the Post Attack Command and Control Systems (PACCS). The total PACCS system consists of eight airborne stations involving a total of 24 aircraft.

The national military command centers are also linked to the sea-based strategic missile forces, either through the appropriate subordinate commands or directly, by means of a deliberately redundant system of Navy radio transmitters and by the Navy TACAMO relay aircraft. To maximize the survivability of communications from the National Command Authority, these Navy transmitters (including TACAMO) can also be reached via those communications links involved in directing SAC forces. (When the authorized force of 12 TACAMO aircraft are available, we will be able to maintain one aircraft continuously airborne over both the Atlantic and Pacific oceans.) Messages could also be relayed to the ballistic missile submarines via general purpose systems on ships at sea, communication satellites, LORAN, etc.

This system of command and control of the strategic offensive forces, however, is not now as survivable as the forces themselves. That is why the Defense Department has proposed, in addition to the improvements in the existing communications networks, the continued development and deployment of the Air Force Satellite Communications System (AFSATCOM), the Advanced Airborne Command Post (AABNCP) aircraft, and the SANGUINE extremely low frequency (ELF) radio relay system. These three special purpose programs offer good prospects for a substantial increase in the survivability and effectiveness of our national command and control system under nuclear attack. They, along with other key systems, are discussed in the following paragraphs.

C³ PROGRAMS

Satellite Communications

The DoD is acquiring and deploying communications satellite systems which primarily address three fundamental communications areas, namely:

- C³ of nuclear-capable forces for which a general-war survivable system is required. This is the Air Force Satellite Communications System (AFSATCOM).
- Support of the WWMCCS using a day-to-day global system which provides protected strategic connectivity between major bases and command centers, large Navy ships, and Advanced Airborne Command Posts (AABNCP). This is the prime mission of the Defense Satellite Communications System (DSCS).
- Fleet communications modernization using a global system to serve the beyond-the-horizon communication needs of ships, antisubmarine warfare aircraft and other mobile forces. This is the Fleet Satellite Communications System (FLTSATCOM).

Satellite communications systems can solve high priority communications problems either not solvable, or more difficult and expensive to solve, or impractical to solve by other means. These systems can also be used as high priority alternate routing for other systems as a means of enhancing survivability. Moreover, the global, changing communications needs of Defense can often be best accommodated by satellite where for modest investment in capacity, great flexibility in geographic allocation can be achieved. Because the price of satellite communications can be high, we stress essential, high priority use of these systems and depend on common carrier lease for the largest percentage of our long-haul routine administrative traffic.

AFSATCOM

A general war survivable satellite communications system for C^3 of our nuclear capable forces must withstand massive physical and jamming attacks in the execution of its mission. This is our goal for the AFSATCOM program. AFSATCOM I, provides us with a global system which will have a modest anti-jam capability. The AFSATCOM I space segment will consist of Air Force transponders installed on host satellites. North polar coverage will be provided by AFSATCOM transponders on the Satellite Data System (SDS). Equatorial coverage will be obtained via transponders on the Fleet Satellite Communications (FLTSATCOM) satellites scheduled for launching in CY 1977. Proliferation of coverage is being obtained through transponders installed on certain other classified hosts. This redundancy will provide the AFSATCOM I space segment with some degree of survivability to physical attack.

The AFSATCOM I airborne and ground terminal program is currently in its test and evaluation phase. A major goal for CY 1975 is successful completion of this phase and the start of production. $12.8 million is associated with this RDT&E effort in FY 1976.

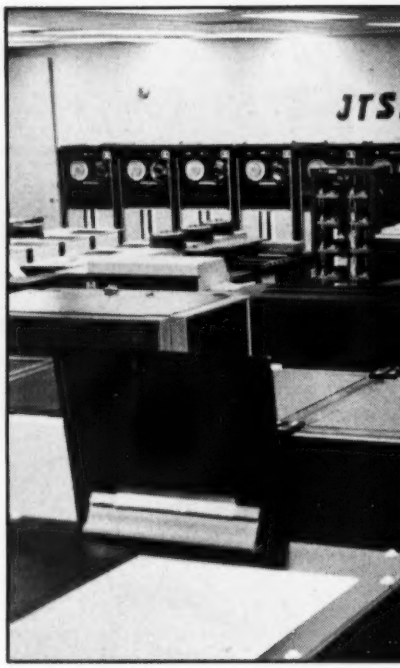
In the meantime, the Air Force is planning for AFSATCOM II, which emphasizes a major upgrade in anti-jam capability and improvement in satellite physical survivability. In support of this effort, two experimental satellites called LES 8 and 9 are scheduled for launch in October 1975. Based on LES 8/9 and other industry/government studies, the Air Force expects by the end of CY 1976 to define an AFSATCOM II which upgrades the space segment survivability and retains the investment in AFSATCOM I earth terminals.

AFSATCOM will employ short, low-speed (teletype rate) messages for force execution, force report back, and force redirection. The use of such messages coupled with suitable anti-jam techniques will permit relatively simple UHF low power terminals aboard our operational vehicles to reliably and securely communicate via satellites which are stressed by large land-based jammers. The RDT&E requirement for these various technology efforts in FY 1976 is $26.7 million.

DSCS

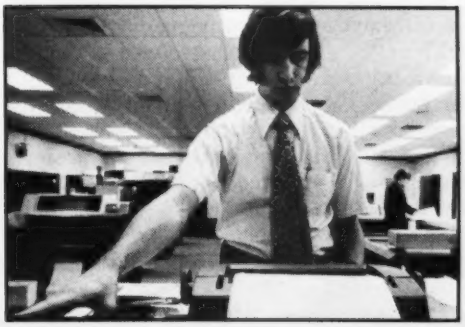
The Defense Satellite Communications System (DSCS) is a high capacity super-high frequency (SHF) system providing protected (anti-jam) secure voice and data links for the WWMCCS. It also supports terminal deployments for contingencies, restoration of disrupted service overseas, presidential travel, global connectivity for the Diplomatic Telecommunications Service, and transmission to CONUS of some surveillance, intelligence, and early warning data collected overseas.

Substantial progress was made by the DSCS in 1974. The two DSCS II satellites launched in late 1973 are working satisfactorily and are serving the Atlantic and Pacific theatres. Two more DSCS II satellites will be ready



for launch in the spring of 1975 and when in orbit will give DSCS global coverage. In 1974 we also contracted for an additional six DSCS II satellites to provide continuity in global coverage in the 1977-80 time frame. Planning for DSCS II satellites which will serve the increased demands of the post-1980 system is in process. This effort will require $12.4 million in FY 1976.

In the DSCS earth terminal area, the modified, upgraded Phase I terminals have been redeployed and are fully operational. Two new heavy terminals are operational and a contract was signed for 15 more heavy terminals for deployment starting in CY 1976. Antennas are being developed for medium and light transportable terminals which employ electronics developed on other terminal programs. Altogether, $13.6 million is requested for DSCS terminal development in FY 1976. By 1979, the DSCS will have over 50 ground terminals deployed globally to provide longhaul communication trunks and fulfill its prime mission, WWMCCS Support.



The operational direction and administrative support of United States military forces worldwide is conducted through the World Wide Military Command and Control System (WWMCCS).

Early in 1974, a program was approved for the acquisition of highly mobile ground terminals for the support of Army, Air Force, and Marine Corps elements deploying in crisis and limited war situations. This terminal capability will be available in the late 1970s and will use the DSCS space segment. In FY 1976, $7.6 million is associated with developing these terminals.

FLTSATCOM

FLTSATCOM is a major and essential step in modernizing Navy communications. It will help relieve the Navy of its almost total dependence on high frequency (HF) transmission for beyond-the-horizon communications and add needed capabilities not possible at HF, such as anti-jam fleet broadcast system of FLTSATCOM.

Like the AFSATCOM, FLTSATCOM operates at ultra-high frequency (UHF), where relatively low cost terminals with simple antennas are possible for highly mobile platforms. Unlike the DSCS, FLTSATCOM will have relatively small capacity because of its much lower operating frequency. Consequently, widespread use of voice circuits is not possible and for this reason the Navy is developing automated message handling systems (IXS) for FLTSATCOM. The program includes the terminal equipment for the fleet as well as the satellites. Terminals are currently being installed and will initially operate (CY 1975/76) via leased transponders on COMSAT's MARISAT covering the Atlantic and Pacific Ocean areas. This is an expedient which is not cost effective but is appropriate in view of FLTSATCOM launch schedules.

During 1974, the FLTSATCOM space segment development program experienced substantial technical difficulties which caused delays and cost growth. The problems, however, are mostly solved and the Navy expects to start production of FLTSAT flight articles in CY 1975. Initial launches will not occur until CY 1977; however, we expect that the COMSAT lease will be extended to provide coverage continuity until the FLTSATs are operational. In FY 1976, a total of $23.1 million is associated with the FLTSAT program.

AABNCP

The Advanced Airborne Command Post (AABNCP) is being developed in increments to take advantage of our growing understanding of the command and control problems in a nuclear war environment. The aircraft (the Boeing 747, now designated the E-4) has the equipment and people needed for flexible command and control of our forces by the National Command Authorities. The aircraft should have a useful life of 20 to 25 years, and during that period, we anticipate a nearly continuous modernization program as new technology becomes available and needed to support our national policy.

Due to the anticipated changes in command and control technology, the AABNCP program is divided into "blocks." Block I is the currently approved configuration of the AABNCP, and is further divided into three phases. Phase IA will provide an interim National Emergency Air Force Command Post for the NMCS.

The first three operational aircraft will be equipped with C^3 packages transferred from the three existing EC-135s. The first of these aircraft was delivered on 7 December 1974. Phase IB provides for development of an advanced C^3 package using one E-4A R&D aircraft, which was funded in the FY 1973 budget, and later acquisition of three operational E-4As, complete with the new C^3 package. Phase IC of the Block I program consists of retrofitting the first three E-4A aircraft with the new Block I C^3 package for delivery to the Strategic Air Command.

The Phase IB C^3 package, in addition to antennas and terminals for satellite communication, will provide a computer terminal through which the E-4A can connect directly into the WWMCCS ground-based Automatic Data Processing (ADP) system. This equipment will greatly enhance the survivability of Airborne Command Post communications both by providing more powerful communications to overcome nuclear or jamming degradation and by providing interface with the AFSATCOM satellite system and the Defense Satellite Communications System (DSCS). By permitting the aircraft to fly in a larger area, these communications will also enhance its survivability. The new C^3 package, along with greater available space, longer endurance, and other features of the E-4A aircraft, will greatly enhance our command and control under nuclear attack.

Block II has yet to be fully defined. Initial studies will define the airborne ADP system and other needed improvements that are technically feasible, and cost-effective.

The R&D funds requested in the FY 1976 and the Transition Budget, will continue the development of the C^3 package and fund the initial increment of a Block II program. The RDT&E portion of Phase IB is $42.2 million in FY 1976 and $7.8 million in the Transition Budget.

SANGUINE

The effective command and control of our SLBM force, the element of our strategic offensive forces which is the least vulnerable, is of major importance. The present communications links from the NCA to the ballistic submarines are much less survivable than the submarines themselves. More reliable and survivable communications links must, therefore, be provided for these forces.

The SANGUINE system will provide survivable communications to our ballistic missile and attack submarines as they operate at depth and speed. SANGUINE may also have significant utility in communicating with our other strategic forces. The SANGUINE transmitter site will be less vulnerable to nuclear attack and the signals less susceptible to atmospheric disturbances and enemy jamming than any other known communications system. Also, the SANGUINE system will pose no known environmental, ecological or biological dangers to the area in which installed.

Several years of experience at the Wisconsin test site have demonstrated the operational and technical feasibility of the SANGUINE system. We plan to continue system development and prototype testing on a site independent basis, and to make signal propagation measurements in the operational environment. We have tested many potential sites to assist us in final site determination. Further analysis is being accomplished in preparation for a site recommendation. The FY 1976 RDT&E request for SANGUINE is $18.0 million and the Transition Budget request is $4.4 million.

TRI-TAC

The TRI-TAC program was established in May 1971 as a joint Army, Navy, Marine Corps and Air Force program to achieve interoperability among tactical communications systems, avoid duplication among the Services in the development of equipment, reduce proliferation of different types of equipment, and place in the field, in a timely manner, new tactical communications equipment required by the Armed Forces.

The Joint Tactical Communications (TRI-TAC) Office is developing a system "architecture" to insure that the many subelements fit together and efficiently serve military requirements and national policy. A Land-Based Plan and a Naval-Based Plan for TRI-TAC for the post-1980 period have been completed. Transitional plans which take into account each Service's existing inventories are being prepared.

Our objective is compatible equipment to support the Services and joint operations in the early 1980s. The tactical equipment must interconnect with the Defense Communications System (DCS) and interface satisfactorily with our allies, particularly NATO. The latter is to be achieved through coordination rather than through joint development.

A major part of the TRI-TAC program involves multi-channel tactical communications systems for trunking and switching both voice and record communications and of data transmission for computerized weapons systems.

An increased utilization of digital techniques will permit a high degree of communications security in addition to improved reliability and maintainability, faster transfer of information, and reduced size and weight. Initial designs will accommodate analog signals to permit operation with the large existing equipment inventories of our allies and ourselves during the transition.

The Director, Joint Tactical Communications (TRI-TAC), has overall responsibility for the program and provides the plans and system design concept. He monitors the development and procurement of equipment which is accomplished by the Services as assigned by the Director, Telecommunications and Command and Control Systems. In general, a single Service is tasked to develop each equipment for utilization by all the Services. The Army, for

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example, is developing the circuit and message switch, the Air Force the technical control, the Navy a facsimile terminal, etc.

A full-scale engineering development of the AN/TTC-39 family of automatic switches was approved in April 1974. Other equipments currently under development are the secure voice terminals, facsimile terminal, data terminal, short-range wide-band radios, technical control devices and tactical satellite modems.

Contract awards are planned in FY 1976 for tropo-radios, digital group multiplexers, unit level switches and a message composition device. The FY 1976 request for all Services for the TRI-TAC program is $108.8 million.

COMSEC

Communications Security (COMSEC) prevents unauthorized persons from obtaining information through the interception of electrical transmission on telecommunications circuits. It is a continuing program involving: (1) the research, development, procurement, maintenance and operation of cryptographic devices; and (2) the supervision and monitoring of DoD telecommunications to assure an acceptable level of communications security.

In FY 1976 we are requesting $83.3 million in RDT&E funds to continue on-going COMSEC equipment programs and to accelerate the development of voice security. The major effort in FY 1976 is development of the COMSEC equipment for the joint tactical automatic switch being developed under the direction of the Joint Tactical Communications Office (TRI-TAC).

Our current objective is to accelerate development and procurement of (1) COMSEC equipment for Combat Net Radio

Systems, and (2) secure voice terminals for the TRI-TAC System. The Combat Net Radio Systems are being tested in FY 1975/1976.

Some of the equipment developed for TRI-TAC may be used in portions of the DCS, particularly in overseas areas. However, the DCS is just initiating a transition from analog to digital facilities. Thus studies, equipment designs and new technology are required for interoperability of fixed and tactical systems during an extended transition period. One of the most critical areas is the development of an improved automatically switched secure voice network during this period.

We are vigorously pursuing development of automatic crypto key distribution concepts and both narrow- and wide-band voice processing terminal equipments. Technology in large scale integrated circuits is a key factor to the complicated voice processing algorithms required for this application. The program is focused at NSA with complementary efforts by the Services at DCA. A narrow-band secure voice consortium coordinates the narrow-band programs to avoid duplication, address interoperability problems and maximize the prospects for early success.

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Other Programs and Activities

Included within C³ are a variety of on-going multi-Service and Service-unique programs, including selective modernization and testing of existing systems and equipments.

The Navy is in the process of developing a comprehensive architectural plan for a future fleet telecommunications system and the supporting telecommunications-system engineering and analysis capability.

The Navy also has new approaches and techniques for solving current fleet communication deficiencies. These include selective automation of shipboard communication centers, development of optical transmissions systems for use by surface, air and submarine units, investigation of the potential of high frequency radio surface wave components, and engineering development of secure man-portable radio systems for flight deck and damage control use. The Navy is also continuing a project-intensive approach to solving submarine communications problems, and is initiating an integrated radio room project designed to improve the technical management of communications and electronic support measures on board nuclear attack submarines.

As part of our effort to modernize and improve the current WWMCCS, we are initiating development of a new, more reliable, more responsive automated C³ system for CINCSAC. This new system will provide two-way communications between all SAC SIOP executing commanders and the National Command Authorities. In addition, an improved, automated C³ system is being developed and installed for CINCNORAD, primarily to ensure effective processing of critical warning data.

As the WWMCCS becomes more automated, research is required so that the different classifications of defense information can be handled efficiently with a minimal risk of compromise. More efficient means of internetting the computers in the system must also be developed. Both of these areas are being explored by the Joint Technical Support Activity (JTSA) of DCA.

C³ RDT&E RESOURCE SUMMARY

The FY 1976 requirement for RDT&E resources in support of C³ is $522.5 million.

For ease of management, the resources are segregated into the following broad categories:

Category	FY 1976 ($ in Millions)
Tactical	**114.2**
Satellites	**126.4**
Direct Command and Control	**127.6**
Long Haul (DCS)	**30.4**
COMSEC	**83.4**
General Support	**40.6**
TOTAL	**$522.5**

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